भारतीय मानक **IS 11518 : 2023**

Indian Standard

कठोर धातुओं में (चुंबकीकरण) निग्राहिता के निर्धारण के लिए विधि

(पहला पुनरीक्षण)

Method for Determination of Coercivity (Magnetization) in Hard Metals

(First Revision)

ICS 77.040.99

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Powder Metallurgical Materials and Products Sectional Committee, MTD 25

FOREWORD

This Indian Standard (First Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Powder Metallurgical Materials and Products Sectional Committee had been approved by the Metallurgical Engineering Division Council.

The standard was originally published in 1985. In view of the experience gained during these years it was felt necessary to revise the standard again. The following modifications have been made in this revision:

a) Procedure clause had been modified;
b) The standard had been drafted to homogenize its structure and wording with other physical test standards;
c) In **3.1**, units are substituted from kA/m to kA/m or Oersteds (Oe); and
d) Specimen preparation clause is included so as to facilitate the testing of multiple samples.

With the increasing use of hardmetals, a need has been felt to bring out standards on the method of tests for various properties of hardmetals. This standard is one of a series of Indian Standards on this subject. It is hoped that the formulation of this standard would be of considerable use to the industry.

Measurement of coercivity provides a relative comparison of grain size, binder content and may be employed as a non-destructive measurement indicating deviation from a specified norm.

In the preparation of this standard, assistance has been derived from the following international standards:

a) ISO 3326 : 1975 ‘Hardmetals — Determination of (the magnetization) coercivity’.

The composition of the committee responsible for the formulation of this standard is listed in Annex B.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 2022 ‘Rules for rounding off numerical values (*second revision*)’. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

METHOD FOR METHOD FOR DETERMINATION OF COERCIVITY (MAGNETIZATION) IN HARD METALS

1 SCOPE

1.1 This standard specifies a method of determining (the magnetization) coercivity of hardmetals containing not less than 3 percent of a ferromagnetic binder by mass.

1.2 This test method also allows the non-destructive estimate of average grain size in sintered hard metals. It is also appropriate for a wide range of compositions and tungsten carbide (WC) WC grain sizes, and can be used for acceptance of material or product to specification.

2 PRINCIPLE

A test piece is magnetized to technical saturation in a dc magnetic field. The complete demagnetization of the piece, due to reversal of the field, gives the coercivity H_{CM}, where $M = 0$.

3 SYMBOLS AND DESIGNATIONS

3.1 The description of the various symbols are as given below:

Symbol	*Designation*	*Unit*
H	Magnetic field strength	kA/m or Oersteds (Oe)
M	Magnetization of the test piece	kA/m or Oersteds (Oe)
M_s	Magnetization at the technical saturation	kA/m or Oersteds (Oe)
H_{CM}	(Magnetization) coercivity	kA/m or Oersteds (Oe)

NOTE — 1 Oe is equivalent to 79.577 47 A/m.

3.2 Coercivity H_{CM}, in kiloamperes per metre, as applied is the value of the reversed magnetic field required to reduce the intensity of magnetization in the test piece to zero (*see* Fig. 1).

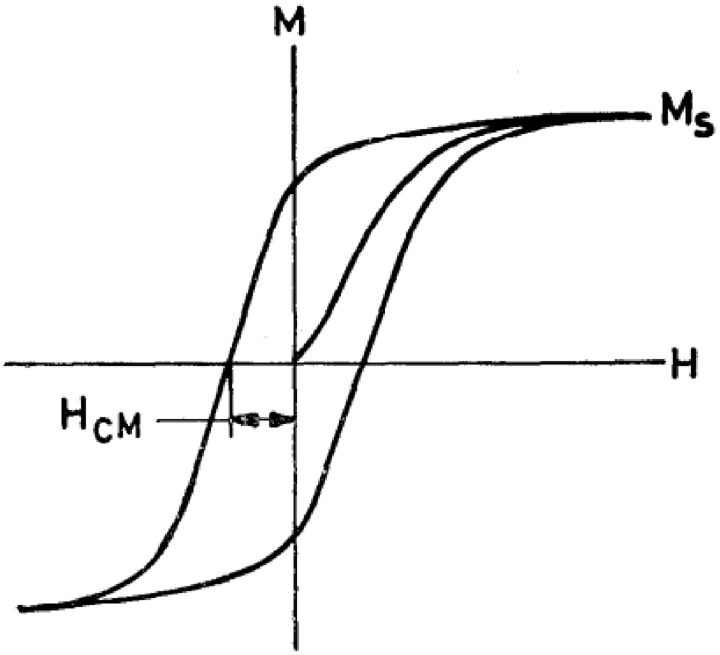

FIG. 1 CURVE SHOWING (MAGNETIZATION) COERCIVITY (HCM)

4 APPARATUS

4.1 Apparatus capable of the de magnetization of the test piece up to the state of technical saturation in the de magnetic field and providing its demagnetization.

4.2 The apparatus shall have an accuracy of 0.2 kA/m for coercivity values up to 20 kA/m and 1 percent for values over 20 kA/m.

4.3 In order to reach technical saturation, the value of the magnetic field strength shall be 200 kA/m to 400 kA/m depending on the type of apparatus used.

5 SPECIMEN PREPARATION

5.1 H_{CM} measurement is non-destructive ‘bulk’ measurement that is averaged over the specimen volume. Bi-modal grain size distributions will give approximately the same H_{CM} value as would be obtained from normal grain size distribution about the same mean value.

5.2 Large test specimens shall be sized to fit within the magnetic field coil spacing available for the apparatus employed.

5.3 It is very difficult to measure the small test specimens, if their size prohibits detection by the magnetic field coils for the apparatus employed.

5.4 Shape of the specimen, that is, symmetry and aspect ratio, influence H_{CM} measurement values and repeatability of results. Place the test piece in a dc magnetic field with its longest dimension in the direction of the field and magnetize it up to technical saturation. Asymmetrically shaped test specimens should be tested in several positions, the measurement values recorded, and the average value reported.

6 PROCEDURE

6.1 The position of the test piece should be placed as given **5.4**.

6.2 Magnetize the test piece to Technical saturation in the dc magnetic field.

6.3 Demagnetize the test piece in the dc magnetic field of reverse direction. The speed of demagnetization must be sufficiently low to give the accuracy specified in **4.2**.

6.4 Determine the coercivity H_{CM} necessary for demagnetization of the test piece.

6.5 Replicate measurement of the same test sample shall be made, reversing the polarity of the saturation and demagnetizing magnet fields, if necessary.

6.6 For samples of asymmetric shapes, repeated measurements shall be made by repositioning the specimen in the de-magnetic field of the instrumentation with consideration being given to the shape, that is, symmetry of the test sample, and to its aspect ratio, that is, length versus width.

NOTE — During the measurements disturbance of the magnetic field from metallic objects like trolley, chair, wrist watch, etc, close to the instruments should be considered and avoided.

7. TEST RESULTS

The result of the determination of coercivity H_{CM} shall be rounded to the nearest 0.1 kA/m.

8. TEST REPORT

The test report shall include the following information:

a) Reference to this standard;
b) Complete identification of the test sample;
c) The result obtained (KA/m) or Oersteds); and
d) Details of any occurrence which may have affected the result.

ANNEX A

(*Foreword*)

INTERNATIONAL SYSTEM OF UNITS (SI UNITS)

Base Units

Quantity	*Unit*	*Symbol*
Length	metre	m
Mass	kilogram	kg
Time	second	s
Electric current	ampere	A
Thermodynamic temperature	kelvin	K
Luminous intensity	candela	cd
Amount of substance	mole	mol

Supplementary Units

Quantity	*Unit*	*Symbol*
Plane angle	radian	rad
Solid angle	steradian	sr

Derived Units

Quantity	*Unit*	*Symbol*	*Definition*
Force	newton	N	1 N = 1 kg.m/s^2
Energy	joule	J	1 J = 1 N.m
Power	watt	W	1 W = 1 J/s
Flux	weber	Wb	1 Wb = 1 V.s
Flux density	tesla	T	1 T = 1 Wb/m^2
Frequency	hertz	Hz	1 Hz = 1 c/s(s^{-1})
Electric conductance	siemens	S	1 S = 1 A/V
Electromotive force	volt	V	1 V = 1 W/A
Pressure, stress	pascal	Pa	1 Pa = 1N/m^2
Magnetization	Oersteds	Oe	1 Oe = 79.577 47 A/m

ANNEX B

(*Foreword*)

COMMITTEE COMPOSITION

Powder Metallurgical materials and Products Sectional Committee, MTD 25

Organization	*Representative(s)*
Indian Institute of Technology Kanpur, Kanpur	Dr. Anish Upadhyay **(*Chairperson*)**
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Member Secretary
Shri G. Ram Sai Kumar
Scientist 'B'/ Assistant Director
(Metallurgical Engineering), BIS

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Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected

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